Remarks

The examiner's reconsideration of the application is urged in view of the amendments above and comments which follow. It is submitted that no new issues are raised by the amendments which are due to what appears to be a fundamental misunderstanding of the terminology utilized in the claims.

The examiner has rejected many of the claims, including independent claim 1, as being anticipated by either Isogai U.S. Patent Number 6,188,093 or Takemoto U.S. Patent Number 4,148,048. Reconsideration is requested.

Unfortunately, the Examiner still has misunderstood the term "non-carrier storing, carrier collecting region" of claim 1: he now seems to indicate that "non-carrier storing" would mean "storing non-carriers", whereby "non-carriers" are opposed to "carriers", which are, as mentioned in the patent application, electrons or holes.

Therefore, "non-carrier storing, carrier collecting region" has been interpreted as a region in which non-carriers are stored and carriers are collected.

Clearly, "non-carriers" do not exist, and, contrary to what the Examiner suggests, it has never been meant to designate holes by "non-carriers" and electrons by "carriers" (both being carriers according to the description, page 7 lines 9-10). The skilled person is well aware that holes and electrons are both "carriers".

In order to overcome this misunderstanding, the claims are amended as above. Only the elected claims are amended in this set of claims.

In the claims, the terminology "non-carrier storing, carrier collecting region" has been replaced by "region for collecting but not storing carriers". This should make clear what the function of that region is: to collect carriers and not store them, i.e. to collect them and evacuate them immediately. The above terminology is thus replaced by a functional limitation as required by the Examiner.

Likewise, the terminology "non-carrier storing, planar current flow, carrier transport pathway" has been replaced by "planar current flow, carrier transport pathway in which carrier transport pathway carriers are not stored". Again, this should make clear what the function of that pathway is: transporting carriers, but not storing them.

This corresponds to the specification, where it is said (page 8 lines 14-16): "[...] the carrier collecting region 3 will attract electrons e-. It does not, however, contain a neutral area can thus not store charge [...] nor is it intended to store charges in this region." This is also repeated at the following passage (page 11 lines 18-19): "The collecting region 3 is unable to store any charge, so that the collected electrons diffuse towards an area of lower potential." Or thus: the collection region can collect charges, but not store them.

The same holds for "non-carrier storing" with respect to the carrier transport pathway: (page 11 lines 22-29): "The potential diagram of the [...] non-carrier storing transfer pathway [...] may be described as a potential saddle point. [...] The saddle collects the carriers without storing them."

* * *

If properly interpreted, the "non-carrier storing, carrier collecting region" is not present in Takemoto, nor in Isogai.

Isogai (US-6188093)

In the Isogai patent, the charge collection region (Fig.10, ref.12) is called an "accumulation region" (col.26 l.32-33), i.e. charge is not only collected there, but also accumulated, thus kept or stored. If this region would be a non-carrier storing region, charge would not be able to accumulate there, as accumulation of "things" (be it tangible things or energy for example, or charges as in the patent application) can only occur if a plurality of those "things" are brought to a common place and are kept there.

In the introduction of the detailed description (col.14 l.15-54) of Isogai, it is explained that the photodiode generates and accumulates an electric charge in response to incident light (col. 14 l.20-21). A transfer gate then transfers the electric charge generated and accumulated by the photodiode to a gate region of a JFET (col.14 l.30-32). The JFET receives the electric charge

at the gate region, and outputs a signal corresponding to this electric charge received at the gate region (col.14 l.22-25).

Charges are evacuated from the charge accumulation regions if an excessive charge is generated at the photodiode of a pixel (col.26 l.37-45). At that moment only the excess charges are evacuated, so charge is still accumulated at the charge collection region (col.14 l.66-col.15 l.5). As evacuation requires a special procedure which has to be applied at a certain time, than charges accumulated before that specific time have to be stored until ready for transfer. Thus this region collects and stores charges as opposed to the present invention which collects but does not store.

The present invention is an improvement compared to what is disclosed in Isogai. By arranging the non-storing pathway, all the charges are transferred. This means that the claimed sensor is more sensitive than the prior art.

Takemoto (US-4148048)

In the Takemoto patent, Fig. 2, there is an n-type diffused layer 12 and an n-type diffused layer 14. As stated in col.1, l.59-67 of the Takemoto patent, charges are created in the substrate when light is incident on the photodiode, and are stored there (col.1 l.62). When a suitable pulse is applied on the gate electrode, charges are drawn to the n-type diffused layer 14. Upon incidence of light, the n-type diffused layer stores charges until a pulse is applied to the gate (col.2 l.1-5),

i.e. charges are accumulated in the n-type diffused layer 12 from where they are evacuated at a moment in time. The charge collecting region, which is formed by the n-type diffused layer 12, is thus a charge storing region.

* * *

Therefore, none of the devices described in the mentioned prior art references is provided with a "region for collecting but not storing carriers". Instead, the carrier collecting region in the devices described in the prior art documents is a carrier storing region, i.e. a region where charges accumulate and are stored until they are transferred for read-out.

In the "region for collecting but not storing carriers" according to the present invention, charges are taken away as soon as they arrive there. They are not stored there at any moment in time. The charges pass by the "region for collecting but not storing carriers", but they are not confined there.

This provides significant advantage if the sensor is to be used at low light levels, for example, as all charges are transferred and can thus be read out.

* * *

Given the above, it is submitted that the claims of the present application under examination distinguish from and are allowable over the references. Further and favorable reconsideration by the examiner is therefore urged.

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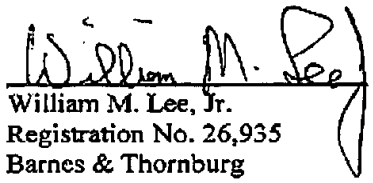
Respectfully submitted,



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Version With Markings To Show Changes Made

1. (Amended) ~~An~~ pixel structure comprising:

a semiconductor substrate;

a radiation sensitive source of carriers in the substrate;

a ~~non-carrier storing, carrier collecting~~ region in the substrate for collecting but not storing carriers;

at least one doped or inverted region of a first conductivity in or on the substrate; and

a least one ~~non-carrier storing,~~ planar current flow, carrier transport pathway from or through the carrier collecting region to the at least one doped or inverted region, in which carrier transport pathway carriers are not stored.

6. (Amended) The pixel structure according to claim 1, wherein the ~~non-carrier storing, carrier collecting~~ region for collecting but not storing carriers is substrate under a polysilicon cover layer.

7. (Amended) The pixel structure according to claim 1, wherein the ~~non-carrier storing, carrier transport~~ region for collecting but not storing carriers is diffusion limited.

8. (Amended) The pixel structure according to claim 1, further comprising at least one implant confining the ~~carrier collecting~~ region for collecting but not storing carriers along at least one dimension thereof.

9. (Amended) The pixel structure according to claim 1, further comprising regions of a second conductivity type in or on the substrate avoiding touching of the ~~carrier collecting~~ region for collecting but not storing carriers and a field oxide.